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On the Observation of Position Angles of Polar Double Stars.

By R. T. A. Innes.

The coordinates of an equatorial telescope do not, in general, coincide with those of the sky. Error is thus introduced into measures of position angle determined with the micrometer adjusted to the instrument. This question has been considered by Chauvenet (vol. ii. pp. 393, 394), but the formula he arrives at is not adapted for use in practice. In the case of stars some distance from the pole the instrumental errors are wholly eliminated by allowing the stars to travel along the wire by diurnal motion, and so refer the zero of the position circle to the sky itself. This method was even adopted in the case of *Polaris* by Otto Struve (Pulkowa Observations, vol. ix. p. 10). Experiments show that this is a very tedious method in the case of polar stars, and one requiring repeated observations to secure accuracy. The following method is both extremely simple and accurate :—

Set on the polar star to be measured; find the instrumental zero of the micrometer position circle by moving the telescope in declination by the slow-motion handle; then determine the star's position angle and add to it the instrumental hour angle less the real hour angle (in arc).

The rationale is as follows :—

Adopting as far as possible Chauvenet's notation (vol. ii. p. 375) we have

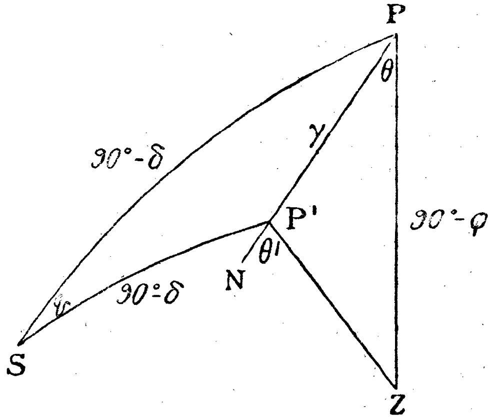

Fig. 1.

P = pole of sky
S = star
ZPS = τ = hour angle of star
PS = $90^\circ - \delta$ = polar distance of star
ZPP' = θ
PP' = γ
PZ = $90^\circ - \phi$ = colatitude
P'PS = $\tau - \theta$
Po = observed position angle

P' = pole of instrument
Z = zenith
ZP'S = t' = instrumental h. angle of star
P'S = $90^\circ - \delta'$ = instrumental p.d. of star
ZP'N = θ'
PSP' = q
ϵ = spherical excess of the triangle PSP'
PP'S = $180^\circ - \text{SP'N} = 180^\circ - (t' - \theta')$
p = true position angle = $P_0 + q$

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The sum of the three angles of PP′S gives

$$q+\tau-\theta+180^\circ-t'+\theta'=180^\circ+\varepsilon$$

whence

$$q=t'-\tau+\theta-\theta'+\varepsilon$$

or putting

$$t'-\tau=\Delta\alpha$$

$$q=\Delta\alpha+\theta-\theta'+\varepsilon \quad \ldots \quad \ldots \quad \ldots \quad (A)$$

Chauvenet (vol. ii. p. 378) shows that, when the instrument is so adjusted that cos γ can be assumed equal to unity, we have

$$\theta-\theta'=\gamma \sin\theta \tan\phi.$$

In a fairly adjusted instrument $\gamma \sin\theta$ should be under 2′, so that $\theta-\theta'$ is negligible. Still, should $\theta-\theta'$, which is a constant for all stars, be thought of importance, it can be computed very easily.

To evaluate ε we have

$$\sin\tfrac{1}{2}\varepsilon=\frac{\sin q \sin\tfrac{1}{2}(90^\circ-\delta)\sin\tfrac{1}{2}(90^\circ-\delta')}{\cos\gamma}$$

and giving sin q a maximum value of unity, and taking $\cos\gamma=1$ we have

δ or δ'	ε
80°	52′
85°	12′
88°	2′
88° 50′	0′·6

Therefore for polar stars the equation (A) can be written

$$q=\Delta\alpha.$$

In Chauvenet's method there still remain the corrections due to error in the adjustment of the telescope with reference to its own axes. Chauvenet (vol. ii. p. 393) calls these Q, where

$$Q=90^\circ-QSP'$$

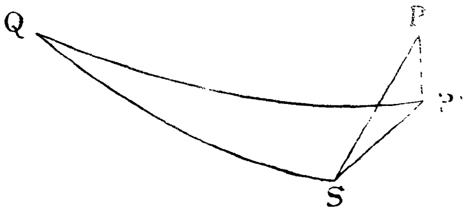

Fig. 2.

and assumes that the zero of the position circle is perpendicular

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to QS. But, as Mr. S. S. Hough has kindly pointed out to me, the zero should be found as previously indicated by setting on the polar star to be measured, and whilst the clock is driving the instrument, moving the telescope in declination until the star keeps on the wire. The zero found in this manner is freed from all errors due to instrumental causes having tan δ or sec δ as a factor, and the necessity to compute Q is evaded.

With instruments such as the McClean and 7-inch refractors of this observatory, where the hour circles show right ascensions direct, the difference between the instrumental R.A. and the star's R.A. gives $15 \Delta a$ at once.

This method gains in accuracy as the star is nearer the pole. It is easily seen that it is applicable even if the star is situated between the pole of the sky and the pole of the instrument. All but the very minute differential effect of flexure is eliminated.

Finally, by using the above method for polar stars and the diurnal motion method for other stars, it is apparent that in neither case is a knowledge of the instrumental constants necessary in the measurement of double stars.

Royal Observatory, Cape of Good Hope:
1901 *January* 11.

Further Corrections to the Armagh Catalogue, with Special Reference to the "Anonymous" Stars. By J. L. E. Dreyer, Ph.D.

Shortly after I had communicated to the Society the list of corrections which appeared in the *Monthly Notices* for November (p. 10), Dr. Ristenpart, who is engaged in the preparation of a general catalogue of stars, kindly sent me a list of Corrigenda, chiefly referring to wrong degrees or minutes and similar errors. At the same time he requested me to examine the original records in order to solve a number of questions, chiefly concerning the identity of the "anonymous" stars in the Armagh Catalogue. I gladly complied with this request, as the publication of the invaluable star catalogues of the *Astronomische Gesellschaft* has now made it possible to decide many cases of doubtful identity which formerly could only have been cleared up by new observations. Some of the suggestions made by Dr. Ristenpart turned out to be correct, or at least to be very plausible; but frequently the examination of the original observations revealed very curious errors, which could never have been suspected by anyone who had not access to the originals. Many of these errors were caused by the fact that the R.A. and P.D. were observed with different instruments, and most of them could have been avoided by greater care on the part of the observers in describing the star observed and others near it, as well as in recording degrees and minutes.